Worksheet: Boyle's, Charles', and Mixed(Combined) Laws

1. State Boyle's Law and explain what it means. Also include an explaination of each of the variables and a graph representation of this law.

2. Some oxygen occupies 250 ml when the barometer reads 100 kPa. How many kPa will it occupy when the volume is reduced to 240 ml? (104.17 kPa)

3. A gas collected when the pressure is 200 kPa has a volume of 380 ml. What volume will the gas occupy at standard pressure? (750.06 ml)

4. A gas has a volume of .1 L when the pressure is 135 kPa. How many mL will the gas occupy at 100 kPa? (135 ml)

5. A gas has a volume of 220 ml when the pressure is 60 kPa. How many kPa will the gas occupy at 280 ml? (47.14 kPa)

6. A gas has a volume of 240 ml at 70 kPa pressure. What pressure is needed to reduce the volume to 60 ml? (280 kPa)

7. State Charles's Law and explain what it means. Also include an explaination of each of the variables and a graph representation of this law.

8. If 100 ml of hydrogen gas is collected when the temperature is 27°C, how many ml will hydrogen occupy at 46°C? (106.33 ml)

9. A gas measures 2.5 L at 29°C. What will be the volume of the gas in milliliters at standard temperature? (2259.93 ml)

10. The volume of a gas is 1164 ml at 18°C. What is its volume at standard temperature? (1092 ml)

11. What temperature must 600 ml of a gas at 20°C be changed to lower its volume to 540 ml? (263.70 K)

12. To what Celcius temperature must 580 ml of oxygen at 17°C be raised to increase its volume to 700 ml. (77°C)

13. State the Combined(Mixed) Gas Law and explain what it means. Also, include an explaination of each of the variables.

14. A gas collected when the temperature is 25°C and the pressure is 100 kPa measures 525 ml. Calculate the volume in milliliters at -10°C and 80 kPa. (579.17 ml)

15. A gas collected when the temperature is 20°C and the pressure is 200 kPa measures 425 ml. Calculate the volume at STP. (781.62 ml)

16. A gas has a volume of 12 ml and pressure of 80 kPa at 27°C. Calculate the temperature at 50 ml and 120 kPa. (1875 K)

17. A gas has a volume of 80 ml and a pressure of 130 kPa at 40°C. Calculate the pressure at 45 ml and 60°C. (245.88 kPa)

Worksheet: Graham's law, mass-volume, and volume-volume

1. What is the ratio of the speed of hydrogen molecules to that of oxygen molecules when both gases are at the same temperature? Remember that both elements are diatomic. (3.98:1)

2. At a certain temperature, the velocity of oxygen molecules is 0.076 m/s. What is the velocity of helium atoms at the same temperature? (0.215 m/s)

3. What volume of hydrogen at STP can be produced from the reaction of 6.54 grams of zinc with hydrochloric acid? (single replacement rxn) (2.24 L)

4. How many grams of sodium chloride can be produced by the reaction of 112 ml of chlorine at STP with excess sodium? (composition rxn) (0.585 g)

5. An excess of hydrogen reacts with 14 grams of nitrogen. How many liters of ammonia will be produced at STP? (composition rxn) (22.4 L)

6. How many liters of oxygen are required to burn 1.00 liter of methane, CH_4? (combustion rxn) (2 L)

7. How many liters of carbon dioxide will be produced by burning completely 5.00 liters of ethane, C_2H_6? (combustion rxn) (10 L)

8. What volume of oxygen is required to burn completely 401 ml of butane, C_4H_{10}? (combustion rxn) (2.61 L)

Ideal Gas Law

1. What temperature must be maintained to ensure that an 8.3 L flask containing 0.5 mole of a certain gas will show a continuous pressure of 220 kPa. (439.47 K)

2. At 12°C and 140 kPa, 0.05 moles of a gas has a mass of 1.98 g.
   a. Calculate the volume of the gas. (0.8458 L or dm^3)

   b. Calculate the gases formula mass(Recall: formula mass=grams/mol) (39.6g/mol)

3. What volume must be maintained to ensure that 2.1 atm of a 0.75 mole gas at -10°C is stable? (7.71 L or dm^3)

4. What temperature must be maintained to ensure that a 6 .8 dm^3 flask containing 0.25 mole of a certain gas will show a continuous pressure of 80 kPa? (261.85 K)

5. What would be the volume of 28 g CH_4 at standard pressure and temperature? Note: you will need to change grams to moles. (38.97 L)

I. Title: Gas Law Demonstrations

II. Purpose: The purpose of this lab is to observe several experiments and decide if they represent Boyle's or Charles's law, or a pressure change. Additionally, to specify the type of change that occurred.

The choices are as follows:
Boyles' law:

P increases then V decreases
P decreases then V increases
V increases then P decreases
V decreases then P increases

Charles's law:

V increases then T increases
V decreases then T decreases
T increases then V increases
T decreases then V decreases

Pressure change:

P inside is greater than P outside
P outside is greater than P inside

III. Data/ Analysis

For each experiment, state the materials needed, a description of all observations that occurred in the experiment, and finally your choice of the law/ change and why it occurred.

Ex: Experiment # 1

a) Materials: Petrie dish, candle, water, food coloring, match, erlenmeyer flask.

b) Description: A candle was placed in a petrie dish. Colored water was placed in the petrie dish. The candle was lit with a match. The erlenmeyer flask was placed inverted over the lit candle. The colored water rose up the interior of the erlenmeyer flask. The lit candle then extinguished.

c) Why? This experiment represents __________ law. (clue: it is either Boyle's or Charles's)

The colored water rose up the interior of the erlenmeyer flask and the lit candle became extinguished because:____________increased/ decreased and then ___________ increased/ decreased.

IV. Conclusion:

Only two paragraphs this time!!!

a) Tell me what you learned.

b) How do you know you accomplished the purpose?

ICP EXPERIMENT - DIFFUSION OF GASES

INTRODUCTION

Diffusion refers to the spreading and collision of molecules of matter. Although this term is used primarily with gases, diffusion also occurs with both solids and liquids. In this experiment, we will attempt (1) to find the diffusion rates of two gases and (2) to find a relationship between the diffusion rates and the density of the gases. Diffusion rate is the rate at which a substance diffuses. Density refers to the weight of a substance in a certain volume.

MATERIALS

Concentrated hydrochloric acid (HCl)
Concentrated ammonia (NH_3)
Cotton swabs (2)
Glass tube

PROCEDURE

1. Place the glass tube flat on the table.

2. Practice with your lab partner inserting the dry cotton swabs into the ends of the glass tube at the same time.

3. Dip each cotton swab into one of the two chemicals. (AVOID BREATHING THE FUMES)

4. In sert the soaked cotton swabs into the ends of the glass tube and record the time on your data table. Call this time T_1.

5. After a while, a white cloud will appear at the point where the two gases meet. Record and call this time T_2.

6. Measure the distances that each gas travels. Record these distances as $D_{(amm)}$ and $D_{(HCl)}$

7. Clean and dry the tube completely. Repeat the experiment two (2) more times and record a second and a third set of data.

CALCULATIONS

1. Time elapsed during diffusion $T_2 - T_1$

2. Take the averages of the time elapsed and the distances traveled by each gas in the three (3) trials.

3. Calculate the rate of diffusion for each gas: $\text{RATE} = \frac{\text{Average distance}}{\text{Average time elapsed}}$

Include the answers to the following questions as part of your conclusion:

1. Which gas diffused at the faster rate?
2. How does the rate of diffusion relate to the density?

DENSITIES

Hydrochloric acid	1.2 g/ml
Ammonia	.77g/ml

Title

Purpose

Data:

	Trial I	Trial II	Trial III	Avg.
time for diffusion				
Distance NH_3 (cm)				
Distance HCl (cm)				

V. Calculations:

1) Look at chart
2) Look at chart

3a) $R_{NH_3} = \frac{\text{avg. distance } NH_3}{\text{avg. time}} =$

3b) $R_{HCl} = \frac{\text{avg. distance } HCl}{\text{avg. time}} =$

4) Calculate ratio $NH_3 : HCl$ (experimental)

____ : 1 ratio

5) Calculate ratio of $NH_3 : HCl$ (theoretical) use Grahams Law

$$\frac{V_{NH_3}}{V_{HCl}} = \sqrt{\frac{m_{HCl}}{m_{NH_3}}}$$

6) Calculate % error of NH_3

$$\left| \frac{Exp^{\#4} - theor^{\#5}}{theor^{\#5}} \right| \times 100$$

V Write the 2 questions from previous side & 3 paragraphs

I Title: Diffusion of Gases

II. Purpose: You come up with this yourself.

III. Data: Don't forget to get it signed!!!!

	Trial 1	Trial 2	Trial 3	Avg
Time for diffusion(sec)				
Distance NH_3 traveled(cm)				
Distance HCl traveled(cm)				

IV. Calculations:

1. State the time elapsed for diffusion for the three trials(seconds). State the distance traveled by each gas for the three trials(cm to .1). Put it in the chart.

2. Calculate the average of the time elapsed(seconds to .1) AND the average distance traveled by each gas in the three trials.(cm to .1). Put it in the chart.

3. Calculate the rate of diffusion for both gases: (to .0001)
   a. Rate of ammonia= $\dfrac{\text{Avg. distance ammonia traveled}}{\text{Avg time}}$ =

   b. Rate of HCl = $\dfrac{\text{Avg distance HCl traveled}}{\text{Avg. time}}$ =

4. Calculate the experimental ratio between ammonia : hydrochloric acid. (to .01)

5. Calculate the theoretical ratio between ammonia : hydrochloric acid. Use Graham's law. (to .01).

6. Calculate the percent error of ammonia (to .01)

V. Analysis Questions

1. Which gas diffused at the faster rate?

2. How hoes the rate of diffusion relate to the density? Ex: The denser the substance, the rate is__________________(faster/ slower).

VI. Conclusion

Three paragraphs again
- a. summarize the procedure
- b. tell me what learned
- c. how do you know you accomplished the purpose?

Worksheet: Molar Volume

1. Calculate the densities of all the gases in the Appendix
   ammonia through sulfur dioxide (answers are given)

2. Calculate the mass of 5.8 L of methane, CH_4 at STP

3. Calculate the mass of 856 ml of hydrogen sulfide at STP.

4. The density of oxygen is 1.429 g/L at STP. Calculate its molecular mass.

5. The density of chlorine is 3.214 g/L at STP. Calculate its molecular mass.

6. At STP, 200 ml of a gas has a mass of 0.7821 g. Calculate its molecular mass.

7. At STP, 4.7 L of a gas has a mass of 56.32 g. Calculate its molecular mass.

8. What is the mass in grams of 595 ml of hydrogen chloride(hydrochloric acid) at STP.

9. What is the mass in grams of 9.7 L of nitrogen at STP.

***Note: You can only use 22.414 L at STP. If you have conditions other than standard, what would you have to do? Think!!!

Example: What volume of nitrogen measured at 20°C and760 torr is required to react with 5 L of hydrogen measured under the same conditions of temperature and pressure? (ammonia is the product). You can solve this problem more than one way.

Directions: Write the letter in the blank of the answer in column B that best matches the term in column A

Column A

1. ________ $BaNa_2$

2. ________ Fisson

3. ________ Half Reaction

4. ________ Mole

5. ________ Weak Base

6. ________ H1OAg

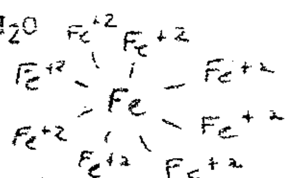
7. ________ Barium

8. ________ $CoFe_2$

9. ________ Specimen

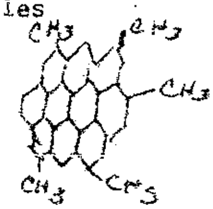
10. ________ CH_2O

11. ________



12. ________ Dipoles

13.



14. ________ Zn

15. ________ H_2O (not a liquid)

16. ________ Br+Br+Br+Br-----Br_4

17. ________ Ba + Au + H_2O

18. ________ Nitrogen

19. ________ NO_3^{-1}

20. ________ Holiday greeting

Column B

A. Two Europeans

B. A place to wash one's hands

C. A breakfast beverage

D. Very powerful alcoholic drink

E. Found at an amusement park

F. Hexamethyl chicken wire

G. $NaHCOO_3$

H. Tropical fruit

I. $MeRe_2$KRISMAS

J. Written when you don't know the whole reactio[n]

K. A reaction that goes to the right

L. HIJKLMNO

M. Small burrowing animal

N. Associated with Tonto' partner

O. What they do with dead people

P. Used to support an unwanted vase

Q. A cold weather reaction

R. A sport or summer relaxation

S. Italian astronauts

T. Found in the Mediterranean

U. Night club dancer

V. House + H_2O = ?

W. A purple people eater

X. Charge when you call after 6 pm.

Y. Presidential candidate in 1964

Worksheet: Collection over Mercury and Water

1. What is the pressure of the gas in an eudiometer when the mercury level in the tube is 12 mm higher than that outside? The barometer reads 720 mm.

2. What is the pressure of the gas in an eudiometer when the mercury level in the tube is 10 mm lower than that outside? The barometer reads 680 mm.

3. The volume of oxygen in an eudiometer is 44 ml. The mercury level inside the tube is 25 mm higher than that outside. The barometer reading is 760 mm. The temperature is 24°C. What will be the volume of the oxygen at STP?

4. Hydrogen, 35 ml, was collected in an eudiometer by displacement of mercury. The mercury level inside the eudiometer was 40 mm higher than that outside. The temperature was 25°C and the barometric pressure was 740 mm. Convert the volume of hydrogen to STP.

5. A gas collected by displacement of mercury in an inverted graduated cylinder occupies 60 ml. The mercury level inside the cylinder is 25 mm higher than that outside. The temperature is 20°C. The barometer reading is 715 mm. Convert the volume of the gas to STP.

6. 60 ml of hydrogen is collected in an eudiometer by displacement of water. The level inside the tube is 40 mm higher than that outside. The temperature is 33°C and the barometric pressure is 720 mm. Convert the volume of hydrogen to STP.

7. A gas is being collected by water displacement. The volume of a gas in the eudiometer is 20 ml. The level inside the tube is 18 mm higher than that outside. The barometer reads 725 mm. The temperature is 5°C. What will be the new volume at -10°C and 740 mm.

8. Some nitrogen is collected by displacement of water in a gas measuring tube. The gas volume is 30 ml. The liquid inside and outside the tube are the same. The temperature is 30°C and the pressure is 750 mm. Convert the volume to that of dry gas at STP.

ADJUSTING WATER VAPOR IN MILLIMETERS OF MERCURY

C	mm	C	mm	C	mm	C	mm
0.0	4.6	17.5	15.0	22.5	20.4	30.0	31.8
5.0	6.5	18.0	15.5	23.0	21.1	35.0	42.2
7.5	7.8	18.5	16.0	23.5	21.7	40.0	55.3
10.0	9.2	19.0	16.5	24.0	22.4	50.0	92.5
12.5	10.9	19.5	17.0	24.5	23.1	60.0	149.4
15.0	12.8	20.0	17.5	25.0	23.8	70.0	233.7
15.5	13.2	20.5	18.1	26.0	25.2	80.0	355.1
16.0	13.6	21.0	18.6	27.0	26.7	90.0	525.8
16.5	14.1	21.5	19.2	28.0	28.3	95.0	633.9
17.0	14.5	22.0	19.8	29.0	30.0	100.0	760.0

Table 9

DENSITY AND SPECIFIC GRAVITY OF GASES

Gas	Density (grams per liter S.T.P.)	Specific gravity (air standard)	Gas	Density (grams per liter S.T.P.)	Specific gravity (air standard)
ammonia	0.771	0.596	hydrogen chloride	1.640	1.268
carbon dioxide	1.977	1.529	hydrogen sulfide	1.539	1.190
carbon monoxide	1.250	0.967	methane	0.716	0.554
chlorine	3.214	2.486	nitrogen	1.251	0.968
dinitrogen monoxide	1.977	1.529	nitrogen monoxide	1.340	1.036
C_2H_2 ethyne (acetylene)	1.172	0.906	oxygen	1.429	1.105
hydrogen	0.0899	0.0695	sulfur dioxide	2.927	2.264

Table 10.

SOLUBILITY OF GASES IN WATER

Volume of gas (reduced to S.T.P.) that can be dissolved in 1 volume of water

Gas	0° C	10° C	20° C
air	0.0292	0.0228	0.0187
ammonia	1176	902	702
carbon dioxide	1.713	1.194	0.878
chlorine	4.54	3.148	2.299
hydrogen	0.0215	0.0196	0.0182
hydrogen chloride	506.7	473.9	442.0
hydrogen sulfide	4.670	3.399	2.582
nitrogen	0.0235	0.0186	0.0155
oxygen	0.0489	0.0380	0.0310
sulfur dioxide	79.79	56.65	39.37

Advanced Chemistry

Series I Number 8

Determining the Molar Volume of a Gas

In this experiment you will determine the volume of hydrogen gas which is produced when a sample of magnesium reacts with 6 M HCl. This is a solution of hydrogen chloride gas in water. The volume of the hydrogen gas produced will be measured at room temperature and pressure, conditions that matter when determining the volume of a gas. The data you obtain will enable you to answer the question: What volume will one mole of dry hydrogen gas occupy at STP?

Procedure:

1) Obtain a piece of magnesium ribbon approximately 4 cm long. Measure the length of the ribbon carefully and record this to the nearest 0.01 cm. Your teacher will tell you the mass of 1.00 meter of the ribbon. Since it is uniform in thickness and width, you can calculate the mass of the magnesium you used.
2) Put the magnesium ribbon into a cage of fine copper wire so that no magnesium could get loose.
3) Set up a ring stand and utility clamp in position to hold a 50 ml gas-measuring tube. Fill a 400 ml beaker about two-thirds full of tap water. Place it near the ring stand.
4) Incline the gas-measuring tube slightly from an upright position and pour in about 10 ml of 6 M HCl.
5) With the tube in the same position, slowly fill it with tap water from a beaker or bottle. While pouring, rinse down any acid that may be on the side of the tube so that the liquid in the top of the tube will contain very little acid. Try to avoid stirring up the acid layer in the bottom of the tube. Bubbles clinging to the side of the tube can be dislodged by tapping the tube gently. It should be filled until it overflows.
6) Insert the stopper containing the copper wire and magnesium into the gas-measuring tube. Invert the tube, holding your finger over the stopper, and place it into a beaker of water. The acid, being more dense than water, will fall down through the water and will eventually react with the metal.
7) After the reaction stops, wait about 5 minutes to allow the tube to come to room temperature. Dislodge any bubbles clinging to the side of the tube.
8) You will need to measure and record the following values: a) Mass of magnesium ribbon in grams per meter (from teacher) b) Length of magnesium ribbon used. C) volume of hydrogen and water vapor collected. d) Temperature of the water and room. e) Barometric pressure. f) Vapor pressure of water at the temperature of the room (from a book). g) the distance between the meniscus in the gas measuring tube and the meniscus in the beaker (use a ruler).
9) Remove the gas measuring tube from the water and pour the acid solution it contains down the sink. Rinse the tube with tap water and then with distilled water.

Calculations:

1) Determine the pressure of the hydrogen gas in the tube at STP. You will need to correct for hydrostatic pressure and water vapor pressure before you use Boyle's and Charles' laws to correct for pressure and temperature.
2) Determine the number of moles of magnesium that reacted. Using the equation for the reaction, determine the moles of hydrogen produced.
3) Determine the molar volume by dividing the liters of gas at STP by the moles of gas.

Questions:

1) Why is it necessary to correct the values mathematically? Why not measure the molar volume directly?
2) Using the kinetic molecular theory (see book) explain why all gases occupy the same volume under the same conditions.
3) Why is it necessary to use Kelvin in all gas law calculations?
4) Why was it necessary to determine the mass of the ribbon using its length? (why not directly?)
5) What experimental factor has the greatest effect on the final value? (things you measured).
6) List possible experimental errors and tell how each one effects your answer. (at least 3).

Lab: Molar Volume

Data Table:

a. length of the Mg ribbon____________cm

b. volume of the hydrogen gas and water vapor produced(gas collected)_____________ml

c. temperature of the room____________°C

d. barometric pressure______________mm Hg

e. distance between the meniscus of water in the tube and the level of water in the beaker_____________cm (note: there may be no difference)

f. mass per meter of Mg ribbon(given by the teacher)______________g/ m

g. vapor pressure of water at the temperature of the room(look in the CRC handbook______________mm Hg

Advanced Chemistry Sample Lab Write-up

Series I Number 10 Molar Volume of a Gas

Method: This section is a brief description of the lab that allows the reader to have a basic understanding of how the lab was done. It will not include quantities. It should not be a procedure that someone could follow to do the lab.

Data: 1) Length of Mg strip .... 4.1 cm
2) Room temperature.. 20.2 C
3) Room pressure.. 771.2 mmHg
4) Volume of H_2 gas in tube.......................... 41.12 ml
5) Distance from meniscus to meniscus....... 12.8 cm
6) Mass per meter for Mg ribbon used.......... 1.0065g/m *
7) Vapor pressure of water at given temp..... 17.753mmHg **

* Value given by teacher - mass taken on an analytical balance
** Obtained from the Chem/Phys Hand Book for 20.2 C

Introduction: In this lab hydrogen gas was collected in a tube by reacting magnesium metal with a dilute solution of hydrochloric acid. Knowing the amount of magnesium that reacted , along with the chemical equation, the moles of hydrogen gas produced can be determined. Using this value and the volume of gas measured on the gas tube, the amount of volume per mole of hydrogen gas can be determined. A slight problem does exist, however. The volume a gas occupies is temperature and pressure dependent. We would like to know what that volume is under some standard conditions. We will use STP conditions, which would be 273.15 C and 760 mmHg. Unfortunately, we cannot duplicate these conditions in the room. It is therefore necessary to mathematically correct conditions in the following steps using gas laws.

1) Correct the volume of hydrogen for water vapor contained in the tube - When a gas is collected over water, the gas will contain water vapor as well as the gas produced in the reaction. The water vapor can be corrected for mathematically using Dalton's Law of Partial Pressure. It states that the total pressure of a system of gases is equal to the sum of the partial pressures of the gases that make up that system. In this case, there are two gases, hydrogen and water vapor. (At this point it is assumed that the internal pressure is equal to the external or barometric pressure. This is not the case and will be explained and corrected for in the next calculation). The partial pressure of water vapor in a sample of gas over liquid water is temperature dependent. This partial pressure was obtained from the Chemistry/Physics handbook. It will be subtracted from the barometric pressure to determine what the pressure of the hydrogen gas would have been if there were no

water vapor present.

$$P_{total} = P_{hydrogen} + P_{water\ vapor}$$
$$771.2\text{ mmHg} = P_{hydrogen} + 17.753\text{ mmHg}$$
$$P_{hydrogen} = 753.447\text{ mmHg}$$

2) Correct for hydrostatic pressure - When the gas tube was inverted, it was inverted into a beaker of water. The level of water in the beaker was lower than the water level in the gas tube. Because these levels are unequal, the pressure in the tube is lower than the external pressure. This is called hydrostatic pressure and can be corrected for by measuring the distance between the two levels. Since the gas was collected over water, not mercury, a units adjustment must be made. The barometric pressure is in, mmHg and the hydrostatic pressure is in, mmH_2O. The mmH_2O can be converted to mmHg by using the relative densities of mercury and water. (Density mercury is 13.5 g/ml and water is 1 g/ml) Therefore it takes 13.5 mmH_2O to create the same pressure as 1 mmHg. Once the hydrostatic pressure is converted to mmHg it can be subtracted from the pressure in 1) to obtain the pressure of the dry hydrogen gas.

$$12.8\ cmH_2O = 128\ mmH_2O$$

$$128\ mmH_2O \times \frac{1\ mmHg}{13.5\ mmH_2O} = 9.481481481\ mmHg$$

$$P_{hydrogen\ uncorrected} - P_{hydrostatic} = P_{hydrogen}$$

$$753.447\text{ mmHg} - 9.481481481 = P_{hydrogen}$$

$$P_{hydrogen} = 743.39655185\text{ mmHg}$$

3) Correct the volume of the hydrogen to standard conditions - To determine the volume of 1 mole of hydrogen gas a STP, the temperature and pressure are corrected using the combined gas law. (This law combines Boyle's and Charles' Laws which requires temperatures in Kelvin)

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{(743.39655185\text{ mmHg})(41.12\text{ ml})}{(293.35\text{ Kelvin})} = \frac{(760\text{ mmHg})\,V_2}{(273.15\text{ Kelvin})}$$

$$V_2 = 37.45201325\text{ ml hydrogen at STP}$$

4) Calculate the mass of the Mg reacted - Because the mass of the Mg ribbon used was so small, it could not be measured directly on our centigram balances. Instead, a meter of the ribbon was weighed on the analytical balance by the instructor. A small piece of the ribbon was then used for the experiment. By knowing the length of the ribbon, and the mass per meter, the mass of the small piece of ribbon can be determined by measuring the length. It is assumed that the ribbon is uniform in width the thickness. (4.1cm = .041m)

(Length of ribbon used) (Mass per meter) = Mass of ribbon

(.041 m) (1.0065 g/m) = .0412665 g Mg

5) Determine the moles of magnesium reacted and moles of hydrogen gas produced - In order to calculate the molar volume, the moles of hydrogen must be determine. This can be done by determining the moles of Mg reacted and using the chemical equation. The equation below indicates that every mole of magnesium that reacts produces one mole of diatomic hydrogen. So, the mole of Mg equal the moles of H_2.

$$Mg_{(s)} + 2HCl_{(aq)} \dashrightarrow MgCl_{2\,(aq)} + H_{2\,(g)}$$

$$.0412665 \text{ g Mg} \times \frac{1 \text{ mole Mg}}{24.312 \text{ g Mg}} = .001697371 \text{ mole Mg}$$

$$= ..001697371 \text{ mole } H_2$$

6) Determine the molar volume of Hydrogen gas at STP - The molar volume is calculated using the volume of hydrogen produced and the number of moles of hydrogen produced already calculated.

$$\frac{\text{Liters of Hydrogen}}{\text{moles of Hydrogen}} = \text{molar volume hydrogen}$$

$$\frac{.037452013 \text{ liters hydrogen}}{.001697371 \text{ mole hydrogen}} = 22.06470963 \text{ liters/mole}$$

Rounded to the correct number of significant digits, the final value is:

22 liters/mole at STP

Discussion: Your teacher will talk to you in class about the types of things that go into the discussion. They will include, but not be limited to, 1) An explanation using the Kinetic Molecular theory of why gases all occupy the same volume under the same conditions. 2) Analysis of the value and cause for errors 3) Other pertinent information.

Conclusion: This lab showed that the molar volume of hydrogen gas at STP is 22 Liters/mole.